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PLANT COMMUNITIES OF THE LAKE HAZEN AREA, NORTHERN ELLESMERE ISLAND, AND THEIR POSSIBLE PRE-GLACIAL ORIGINS

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Introduction

The Lake Hazen area has undergone relatively extensive scientific investigation compared to the rest of northern Ellesmere Island. The flora of the area has been documented (Brassard; Powell; Savile; Steere) as have the insects (Leech; Oliver), aquatic habitats (Oliver and Corbet), mammals and birds (Savile and Oliver), soils (Day), geology (Christie, Schei) and glacial geology (England).

The botanical studies of the area, however, have concentrated on the floristics and little work has been done on the quantitative description of the plant communities.

The glacial history of the area during the Late-Wisconsin is uncertain. Several of the studies conducted in the Lake Hazen area have postulated the existence of glacial refugia there (Brassard; England; Leech; Schei) while others suggest glaciation of the entire area (Christie; Savile).

Purpose

This study involves a quantitative description of the major plant communities of the Lake Hazen Camp area including an analysis of their possible ages as related to the Late-Wisconsin glaciation.

The study consists of three phases with the primary focus on the description of the plant communities of the Lake Hazen Old Camp area, including those of McGill Mountain.

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A separate study was undertaken to determine the effect of changes in elevation and temperature on plant growth.

The third phase involves the description of the plant communities of a possible refugium north of Lake Hazen.

Methods

Base camp was established at Lake Hazen Camp (81°49'N, 71°18'W) which is situated on the north shore of the lake. The study area is bounded by the Snow Goose River and Blister Creek to the east and wast respectively and by McGill Mountain to the north and Lake Hazen to the south.

i. Plant Community Description

The area was traversed to determine the major plant communities and intensive sampling sites were established there. Additional smaller communities were described floristically.

Intensive sites were established in eleven different communities. These were located at the lakeshore and up to the first of a system of three terraces. Ten 50 x 50 cm quadrats were placed randomly in each community and cover of both vascular and bryophytic species were estimated. Six quadrats per community were harvested for biomass.

The depth of active layer and slope aspect and angle were measured for each community. One soil pit per community was dug and the profile was examined, described and photographed. Soil samples from different horizons in the pit were collected and will be analyzed for nutrient content.

Thermocouple stations were established at these eleven communities and

temperatures at +25, +5, 0, -3, -5, -15, and -25 cm from ground surface were obtained. Readings were taken once a week. In addition, temperatures over a twenty-four hour period were recorded during mid-summer (early July) and at the end of the growing season (early August).

Several samples of peat were extracted from various depths on the exposed bank of Skeleton Creek, west of camp. Some of these samples will be forwarded for dating with ^{14}C and they will be examined for pollen and macrofossil content.

ii. Microclimate of McGill Mountain

Microclimatological stations were established along the north-east facing slope of McGill Mountain. Thermointegrators were used to determine the effect of elevation on the length of growing season. These were established at four stations; lakeshore, mountain summit, and two stations in between.

Thermocouple stations were set up at eight different points along the slope of the mountain in order to determine the effect the change in elevation has on temperature.

The plant communities of these stations were described and soils were collected for seed and soil analysis.

In addition, six species of plants which occurred at all stations in both exposed and sheltered locals, were collected and examined for leaf length, number of leaves per rosette, surface area per rosette, and surface area per mature leaf.

iii. Peatland Site

This site was visited for two days on July 13 and July 27, 1981 and extensive collecting of both vasculars and bryophytes was done. Due to the lack of time, cover estimates were obtained by throwing quadrats in each community and then photographing them. The frequency of species within each quadrat will be determined this winter by analyzing the photographs.

Results

i. Plant Community Description

Eleven different communities were described from the Lake Hazen area. These were all located between the lake and the lower terrace of McGill Mountain. All of the communities are classified according to the dominant species.

1. *Dryas integrifolia*

This community was situated between Blister Hill, a sandstone outcrop, and camp. Vegetation cover was sparse with *Dryas integrifolia* comprising twenty-five percent of the ground cover. Other plant species present in the area include *Carex nardina*, *Polygonum viviparum* and *Salix arctica*. These plants, however, were present only in trace amounts.

The substrate of this community is sand and the influence of wind on this is evident by the deposition of sand on the *Dryas* clumps.

A soil profile taken in this stand indicates a weakly developed Arctic Brown soil. There is mottling along the pit due to a decay of *Dryas* which has been covered by sand.

Hummocks of *Dryas* are weakly developed.

2. Dryas integrifolia - Carex nardina - Kobresia myosuroides

Much of the study area is comprised of this type of cummunity. Cover of vegetation is approximately thirty-five percent and consists primarily of Dryas integrifolia with some Carex nardina and Kobresia myosuroides.

Much of the ground surface is not covered by vegetation and the soil is cracked due to a lack of moisture. The effect of wind is also evident on the soil surface as small ridges have developed running parallel to the direction of the prevailing winds.

Soil is approximately twenty-five cm of loess overlying rocky glacial drift. Frost activity has resulted in the churning of the boundary layer and rocks have been forced to the surface. Gleyic processes are evident in the lower strata.

3. Carex stans - Moss

Terraces of former lake levels of Lake Hazen are oriented in a southwest - northeast direction. The moisture regime between these terraces is higher compared to much of the upland areas and slopes due to the presence of running water.

The vegetation covers the entire ground surface with sedges (Carex stans) and moss predominating.

The water level in the stream and valley fluctuates throughout the summer. The stream bed was almost dry at the end of June but by mid-July running water was present.

Soils are Tundra soils and are poorly drained. There is no well developed organic layer and loess overlies glacial drift. Gleyic processes are evident ten cm below the surface.

4. Carex stans - Moss - Eriophorum angustifolium ssp triste

This community type predominates on the moist southeast facing slopes of McGill Mountain. Slope angles are between twelve and twenty-one degrees with the steepest angle found at the top of the slope. Streams run downslope and moisture is obtained from the melting of permafrost and runoff farther upslope.

Cover is predominantly Carex stans, Eriophorum angustifolium ssp triste, Dryas integrifolia, and moss. Species of plants occurring in this community with limited distribution elsewhere include Epilobium davuricum ssp arcticum and Saxifraga hirculus ssp propinqua.

Periglacial features include a solifluction lobe located at midslope on one of these valleys.

Soils were not examined in this community this season.

5. Carex stans - Moss - Eriophorum scheuchzeri

There are a number of small ponds located near the camp along the lakeshore in a system of polygons. Some of these ponds retain water for most of the summer while others become completely dry.

The water level of the pond studied fluctuated over the summer but did not become completely dry. The more mesic portion was covered with moss and algae and the sedges were located on more elevated areas on the periphery of the pond.

Soils are sandy and are saturated with water with gleyic processes evident in the lower portion of the profile.

6. Salix arctica - Epilobium latifolium

The beach ridge along the shore of Lake Hazen consists of large gravels. Vegetation is sparse and is restricted to the raised portions of the ridges. Salix arctica and Epilobium latifolium predominate and cover approximately ten percent of the ground surface.

The distribution of the vegetation is in part due to the effect of scouring of the lakeshore by lake ice. As the ice cover of Lake Hazen melts, the ice shifts and is pushed onto shore.

There is no soil development on these gravels.

7. Dryas integrifolia - Salix arctica

This community is situated between the lakeshore and up to the lowest terrace. It is situated on a southwest facing slope of five degrees.

Vegetation covers about thirty percent of the ground surface. Species diversity is low with Dryas integrifolia, Salix arctica and Arctagrostis latifolia comprising the main ground cover. Other species found here include Carex nardina, Festuca cf. brachyphylla and Draba cinerea.

Clay is the substrate and there is no well defined organic layer. Gleyic processes operate as evidenced by the presence of iron intrusions.

Lack of moisture is evident as much of the ground surface has developed large cracks on the surface.

Many of the Salix plants have been uprooted or disturbed by muskoxen.

8. Puccinellia sp. - Agropyron latiglume - Festuca cf. brachyphylla

This community is situated near the Dryas integrifolia - Salix arctica stand on a two degree, southwest facing slope.

There is very sparse vegetation cover with cover approximating two to five percent of the ground surface. Grasses are important components of the vegetation with Puccinellia sp., Agropyron latiglume and Festuca cf. brachyphyll predominating.

The vegetation cover is concentrated in the hollows where there is more moisture available for the plants.

The clay soils here are solonetzic with a deposition of salt found on the bottom of rocks lying on the ground surface.

9. Carex stans - Eriophorum angusifolium ssp triste - Dryas integrifolia

The drier portions of the southwest - northeast trending valleys located between terraces is occupied by a Carex stans - Eriophorum angustifolium ssp triste - Moss - Dryas integrifolia community. It is situated adjacent to the Carex stans - Moss meadow (3). Slight hummock development is evident here.

The soils are Tundra soils and are poorly drained but are drier than those of the adjacent Carex - Moss meadow. Organic matter is found on the top two to three cm and gleyic processes are operating in the lower mineral layers.

10. Dryas integrifolia - Cassiope tetragona

Hummocks of Dryas and Cassiope are well developed in late snowmelt areas, predominantly on northeast facing slopes. Dryas grows on the tops of the hummocks with Cassiope occupying the moister regimes, the sides of the hummocks.

These hummocks are easily detached from the frozen ground.

The loess soils have some degree of horizon development with the organic layer situated beneath the cushion of the plant.

11. Cassiope tetragona

The Cassiope hummock community is not extensive in the camp area and is restricted to northeast facing slopes, areas of late snowmelt.

The hummocks are well developed and Cassiope tetragona and Dryas integrifolia grow on the tops of the hummocks but only Cassiope is found along the sides.

The loess soils have little horizon development and are mottled with organic matter on the periphery.

The hummocks are easily detached with permafrost evident at the bottom of the hummock in the hollows.

Measurements of temperatures at ground surface was highest in those communities situated away from the lake and with low degree of plant cover. These were the Dryas integrifolia - Carex nardina - Kobresia myosuroides, Dryas integrifolia - Salix arctica, and Puccinellia sp. - Agropyron latiglume - Festuca cf. brachyphylla communities.

Comparisons of temperatures at camp with those in the valleys indicate that the lake has a cooling effect on air temperature near shore.

There is a gradient of increasing temperature from twenty-five cm above ground to surface and from twenty-five cm below ground to surface. Temperatures at ground surface were higher than above or below ground for all communities studied.

Intrusions of peat were found in the exposed streambank of Skeleton Creek. Samples of these peats were taken at different levels and will be forwarded for ^{14}C dating. Macrofossil analysis will be conducted this winter.

ii. Microclimate of McGill Mountain

This part of the study was undertaken by Don Gordon, Erindale College, in partial fulfillment of an undergraduate independent study course. The study was completed this year and the results are summarized below.

Air temperatures higher than five cm above ground surface decreased with increasing elevation however, temperatures at ground surface showed no such trend.

Thermointegrators record degree-days (mean temperature above zero) at the ground surface. Elevation did not seem to be an important factor in determining the number of degree-days as the summit station located at the top of McGill Mountain (approximately 3000 ft. ASL) had the second highest degree-day total with the highest total found midslope in a sheltered location. The station on the shore of Lake Hazen exhibited the lowest number of degree-days.

Cover data of vascular species was obtained from each of the eight stations and in general it was found that there was a greater species diversity in the communities of lower elevations. Sheltered stations with mesic soils showed the greatest diversity.

The effect of elevation on the morphology of six plant species was also examined. Plants of Papaver radicatum, Salix arctica, Saxifraga cernua, Saxifraga caespitosa, Saxifraga opposififolia, and Saxifraga tricuspidata

were measured for leaf length, number of leaves per shoot, surface area per leaf, and surface area per shoot. To date, only the data for number of leaves per shoot and leaf length has been compiled and the surface area measurements will be completed this winter.

It was found that leaf length or leaf number were not affected by an increase in elevation.

Soils will be examined this winter for nutrient analysis and germination studies will be undertaken to see if elevation has an effect on the germination of various plants.

iii. Peatland Site

The peatland site, located approximately forty miles northeast of Lake Hazen is thought to have been unglaciated during the Late-Wisconsin based on geomorphological and bryological evidence (J. England, pers. com.). The large accumulations of peat and the existence of large tows indicates that a long period of time was needed for their development (J. England, pers. com.). Three species of moss new to North America have been found here as well (K. England, pers. com.).

The vegetation of this area is extremely lush with one-hundred percent plant cover in some communities and with much species diversity. The plant communities of this site are different than those of the Lake Hazen area. Preliminary studies identify five communities.

1. The plateau, which is relatively dry, has a cover of Festuca sp.- Lichen - Saxifraga oppositifolia.

2. The east-facing slope of the saddle is well vegetated with complete

cover of vascular plant species. The dominant species are Alopecurus alpi and Luzula nivalis.

3. Snowmelt areas on the east-facing slope have a high cover of moss especially Philonotis sp. and Bryum cryophyllum. Luzula cf. nivalis is al an important constituent of this community.

4. Papaver radicatum and Saxifraga nivalis occur in large numbers on moist, north facing slope.

5. The scree slopes near the top of the saddle have sparse vegetatio cover with mosses and lichens comprising most of the plant cover.

Extensive collections of vascular plants was made from all communities at this site and are now being examined. However, detailed community analysis could not be completed in the field due to lack of time.

The phenology of most species in this peatland is approximately two weeks later than that of the Lake Hazen area. Observations of the weather patterns in the Lake Hazen area indicate that the peatland is under cloud cover for a large portion of the summer and precipitation levels may also be higher.

Discussion

The Lake Hazen area is very rich floristically. Powell (1961) lists 114 species of vascular plants in the Hazen camp area. Savile (1964) state that it supports the whole flora of Peary Land. Alexandra Fiord, a High Arctic oasis, has 84 species of vasculars even though it is three degrees farther south than Lake Hazen (Svoboda and Freedman, 1980).

The difference is due to favourable summer temperatures at Lake Hazen. Lake Hazen is situated approximately eighty miles inland and the climate is continental in nature. The air coming into the Lake Hazen valley is dried and warmed by passage over the adjacent mountain range (Savile, 1964).

The plant communities of the Lake Hazen area are diverse. Eleven different communities were identified and studied in the area between the camp and the lowest terrace near McGill Mountain. These communities differed in species composition, soils, and moisture regime.

Moisture is the major factor limiting plant growth here and those sites with available moisture, streambanks, intermittent ponds, late snowmelt areas or small hollows, have more luxurious plant growth than those drier sites.

Powell (1961) and Savile (1964) remarked that increasing elevation at Lake Hazen did not limit plant growth.

The study by D. Gordon indicates that increasing elevation does not have an effect of plant morphology or on soil surface temperature. Other microclimatological factors such as site exposure and character of the substrate are more important.

The plant communities of McGill Mountain were not studied quantitatively during 1981 although plant collections were made. These communities will be studied in more detail in 1982.

Extensive collections of vascular species were done for the area and these will be identified and incorporated into the community descriptions this winter. Preliminary investigations do not indicate endemic or disjunct vascular plant species, which would favour the glacial refugia hypothesis, but the

taxonomy of many of the taxa of northern Ellesmere Island is confusing. At the present time Dr. P. W. Ball, Erindale College, and I are examining the plants from Lake Hazen and Dr. Ball is modifying the taxonomic keys of the more difficult taxa. This will enable future researchers to make better and more reliable plant identifications.

Because of the taxonomic problems of many of these species, one cannot rely on distribution maps like those found in Porsild or in fact, on species lists obtained from previous researchers unless those specimens are examined. It is difficult, therefore, to define endemic or disjunct taxa in this area.

The peatland site is very interesting ecologically as it supports a diversity and richness not found at Lake Hazen. Extensive collections of vascular plant species were made here and these will be compared to those obtained from Lake Hazen.

The apparent increase in precipitation levels here may partially account for the luxious plant growth. Areas adjacent to the peatland site would presumably receive as much moisture yet these areas are sparsely vegetated.

In 1982, a microclimatological station will be erected as was done at Lake Hazen in 1981 and differences in precipitation and solar insolation will be monitored. Soils will also be collected and examined for nutrient content.

NOTES ON BIRDS AND MAMMALS OBSERVED AT

LAKE HAZEN CAMP JUNE 21 - AUGUST 3, 1981

BIRDS

Red-throated Loon (Gavia stellata)

Two pairs nested in the vicinity of camp. One pair nested on an island in a small pond located approximately three km west of camp. One chick hatched out sometime between July 21 and July 25. A second pair nested on the shore of a pond located four km northwest of camp. One egg was laid but as of August 2, the chick had not yet hatched.

It is interesting to note that Savile and Oliver observed two pairs of loons in 1962 nesting on the same ponds. The dates of hatching also coincide. Hatching out occurred on July 20 or 21, 1962 on the nest west of camp whereas it occurred a week later at the nest northwest of camp.

Snow Goose (Chen caerulescens)

A flock of ten individuals was observed flying through Skeleton Creek valley on June 30 and two individuals were seen at a pond four km northwest of camp on July 27. Breeding individuals were not observed at Lake Hazen.

Oldsquaw (Clangula hyemalis)

One pair were observed on a pond near camp on June 22. An additional three individuals were seen throughout the summer on a pond two km northwest of camp.

King Eider (Somateria spectabilis)

One pair was observed on a pond two km northwest of camp on June 22.

An old nest lined with down was seen in the Dryas - Sedge meadow adjacent to the pond but nesting was not observed in 1981.

The pair were observed again on a small pond at camp on July 25, but were not seen for the remainder of the summer.

Long - tailed Jaeger (Stercorarius longicaudus)

Two pairs were breeding in the Lake Hazen area. One nest was located in the Dryas - Sedge meadow near Skeleton Creek, approzimately three km southwest of camp. One chick hatched on July 4. One other nest was situated in the Dryas - Salix community just north of the airstrip. One chick hatched on July 17.

Glaucous Gull (Larus hyperboreus)

Three individuals were observed flying over camp on June 25. They were not observed again during the summer.

Arctic Tern (Sterna paradisaea)

At least one pair nested in the vicinity of camp. The nest was located along the lakeshore on a gravel beach ridge near the Blister Creek delta. The young had not yet hatched by July 21.

Ruddy Turnstone (Arenaria interpres)

One nest was located in the Dryas - Sedge meadow along Skeleton Creek. The young hatched (one chick) on July 2.

Ruddy turnstones were the most abundant bird species of the study area but estimates of numbers were not obtained.

Knot (Calidris canutus)

Knots were breeding in the area although no nests were located. One young chick was seen along the lakeshore near camp on July 3.

Sanderling (Calidris alba)

One individual was observed on the lakeshore of Lake Hazen about two km southwest of camp on July 3.

Rock Ptarmigan (Lagopus mutus)

At least two pairs bred in the study area in 1981. One female with four chicks was seen near the sedge meadow at camp on July 25. Two females, one male and eleven chicks were in camp July 29.

Raven (Corvus corax)

One individual flew near camp on July 24. It was not observed again.

Lapland Longspur (Calarius lapponicus)

One female was seen on a sandstone outcrop at the upper terrace southwest of camp on June 28.

Snow Bunting (Plectophenax nivalis)

There is no estimate of individuals although numbers were quite high. Young were first observed July 8 along Skeleton Creek. By the end of July there were numerous young buntings around camp.

MAMMALS

Arctic Fox (Alopex lagopus groenlandicus)

At least two individuals were observed periodically over the course of the summer. One fox frequented camp, scavaging food. One individual was

often seen at all intensive stations and was observed attacking the micro-climatological equipment.

Arctic Hare (Lepus arcticus)

Arctic hare were very numerous and were frequently seen on the slopes of Skeleton Creek valley. A female and two young were observed at camp from July 18 to August 3.

Arctic Wolf (Canis lupus arctos)

Arctic wolves were seen intermittently during the summer. Three individuals approached camp from the south on June 25. They then proceeded north towards the Snow Goose River. On July 7, three individuals approached from the south and again headed north. Four individuals were observed napping in Skeleton Creek valley on August 1.

Collared Lemming (Dicrostonyx torquatus groenlandicus)

One individual was seen on June 26 in Cassiope - Dryas hummocks, southwest of camp. No others were seen during the summer although burrows were numerous.

Ermine (Mustela erminea arctica)

One individual was seen in Dryas hummocks on Blister Hill, about two km southwest of camp on July 5.

Muskox (Ovibos moschatus)

Muskoxen were first observed in the study area June 21. Two bulls, three cows, and one calf were grazing in the sedge meadows along Skeleton

Creek. Four bulls, three cows and three calves were observed grazing in a meadow on Omingmak Mountain, north of the Snow Goose River on this date.

A herd of fifteen individuals, five bulls, six cows, and four calves, were seen June 24 and 25 in the sedge meadows near camp and also in the Dryas - Salix community.

One lone bull was seen near the lake on June 26 and 27.

A herd of eight were seen grazing in a meadow near the Blister Creek delta on June 29. In addition, two bulls, one cow, and one calf were seen in a sedge meadow behind camp.

Three individuals were seen near the peatland site on July 13.

The lone bull returned to Hazen camp July 20.

A herd of approximately twenty individuals was seen near the Abbe River on July 27.

Peary Caribou (Rangifer tarandus pearyi)

On July 1, two females and two calves were seen in the valley between the upper terraces of the Hazen camp area.

Five individuals, two males, two females, and one calf were observed at the peatland site on July 27.

STATE OF LAKE HAZEN CAMP

Considerable time and effort was invested in a general cleanup and repair of the camp at Lake Hazen. Only one building remains standing, one erected by the Defence Research Board in 1958. The canvas of this shelter is deteriorating and attempts at repairing it were made by securing canvas tarps over the entire structure.

There are numerous piles of old equipment, scientific and military, around camp and an attempt was made to tidy these up.

Defence Reseach Board building and pile of equipment prior to cleanup. Lake Hazen.

Parcoll and miscellaneous equipment. Lake Hazen.

ACKNOWLEDGEMENTS

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CORRECTION

February 10, 1982

pg. 11 - Catherine England has indicated that these three mosses are, in fact, not new to North America and have been recorded by G. R. Brassard in his 1971 publication, The mosses of northern Ellesmere Island, Arctic Canada.

Joyce Gould

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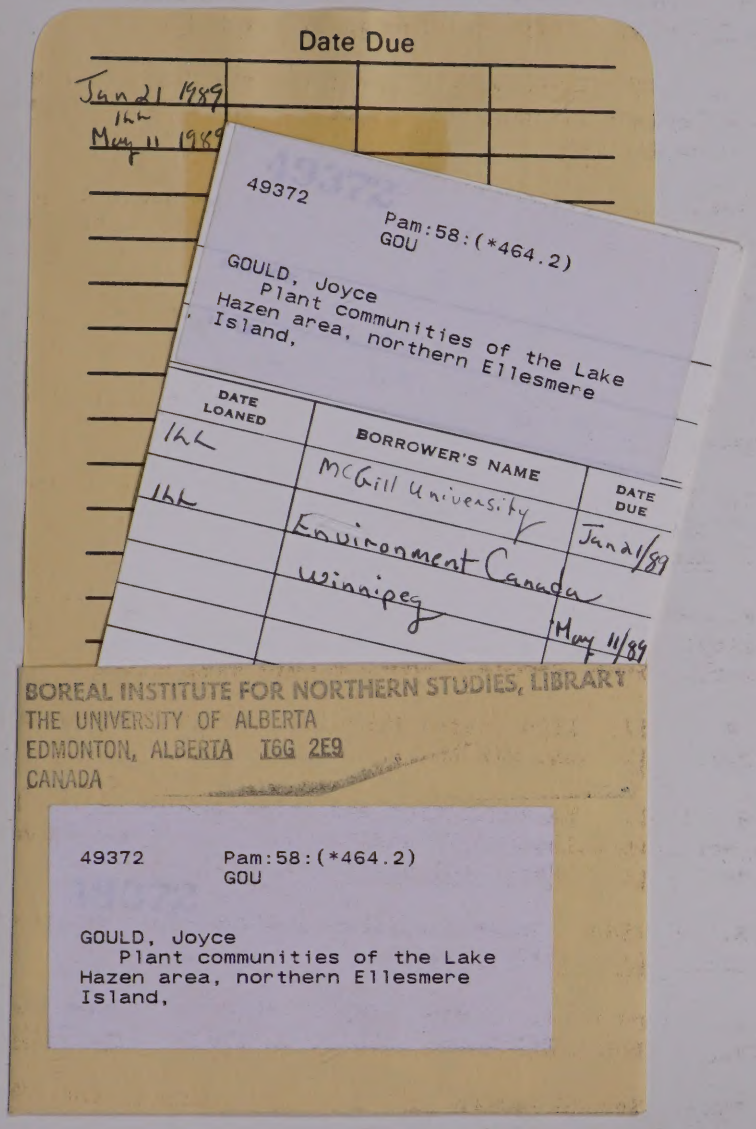
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